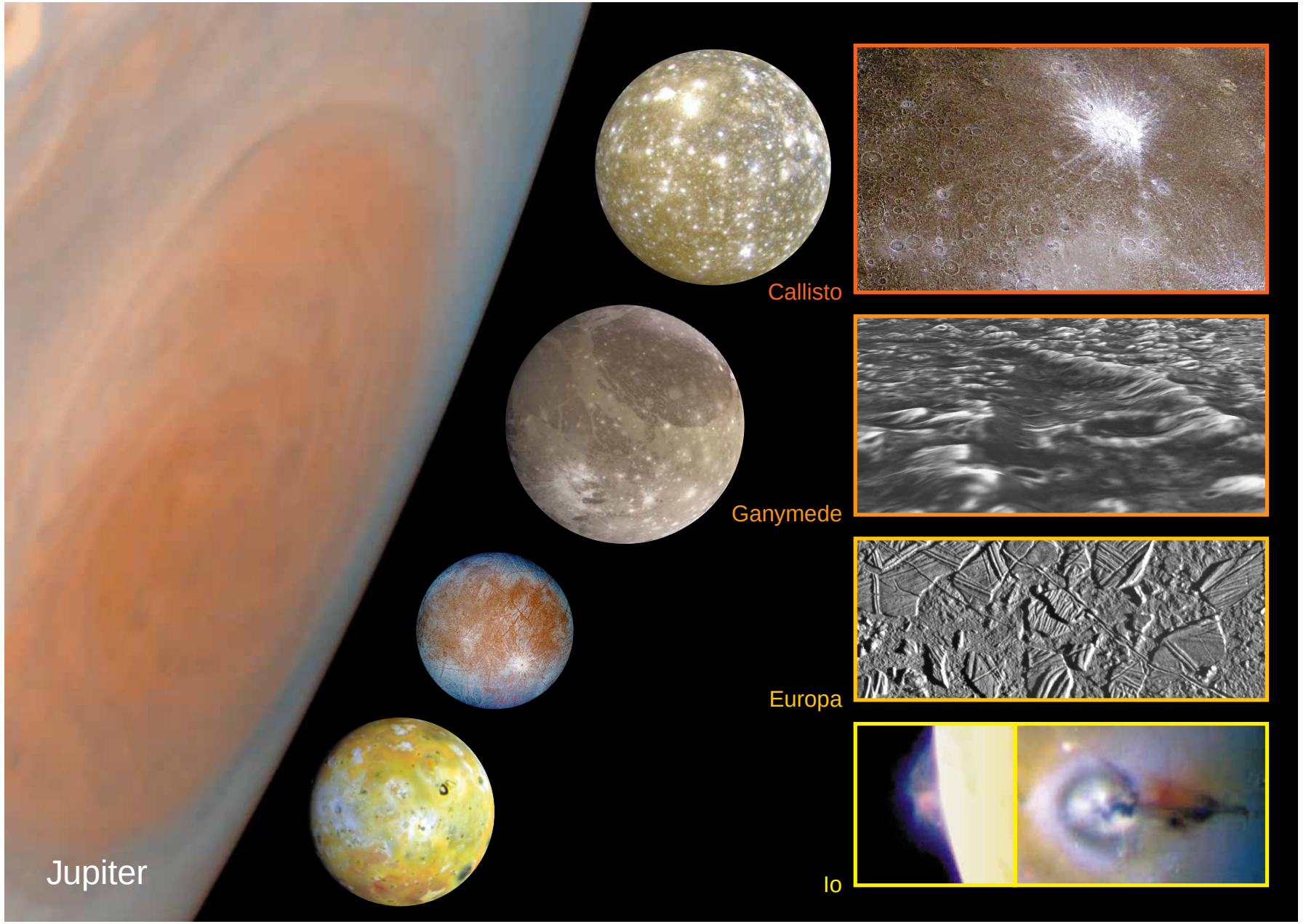
National Aeronautics and Space Administration

Moons of Jupiter



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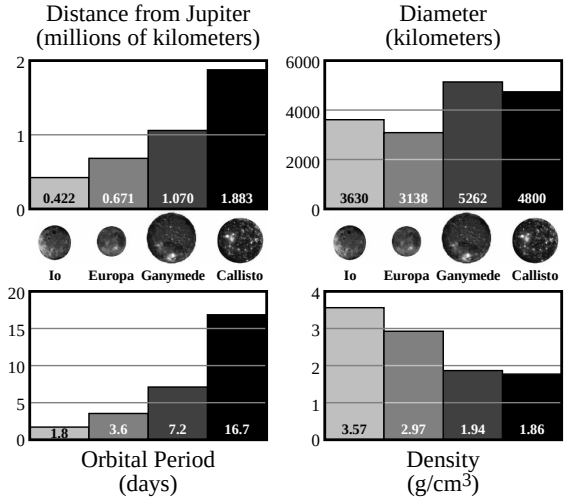
The planet Jupiter's four largest moons are called the Galilean satellites, after Galileo Galilei who discovered them in 1610. These moons, named **IO**, **EUROPA**, **GANYMEDE**, and **CALLISTO**, are particularly intriguing since each has its own amazing distinction in our solar system. Io is the most active volcanic body in the solar system, and parts of its surface often change within weeks. Europa's cratered surface is mostly water ice, and there is strong evidence that it may be covering an ocean of water or slushy ice. Ganymede is the largest moon in the solar system (larger than even the planet Mercury), and is the first moon known to have its own magnetic field. Callisto is extremely heavily cratered, but has surprised scientists with its lack of very small craters that should be visible in Galileo's close-up images - they appear to be covered with fine dust.

Though distinctive, the Galilean moons also have much in common. The surfaces of the outermost three moons are mostly water ice, mixed with rocky, probably carbon-rich, material. Io's surface is mainly sulfur in different colorful forms and sulfur dioxide. As Io travels in it's slightly elliptical orbit, Jupiter's immense gravity causes tides in the solid surface 100 meters high on Io, generating enough heat to drive the volcanic activity and drive off any water. Io, Europa, and Ganymede all have a layered interior structure (as does the Earth). Europa and Ganymede all have a core, a rock envelope around the core, a thick soft ice layer (which on Europa could be liquid), and a thin crust of impure water ice, Io has a core, and a mantle of at least partially molten rock, topped by a crust of solid rock coated with sulfur Compounds. On the other hand Callisto appears to be an ice-rock mix both inside and out. Under the influence of Jupiter's and each others gravity, the Galilean moons all keep the same face towards Jupiter as they orbit (as does our moon towards Earth), This means that each of the moons turns only once on its axis for every orbit about Jupiter.

Galileo originally assigned names I, II, III, and IV to these moons, which were later more artfully renamed for the lovers of Jupiter (also known as Zeus) from Greek mythology. They continued to be studied from Earth through telescopes until the Pioneer (in 1973) and Voyager (in 1979) spacecraft offered striking color views and a global perspective from their midrange flybys while surveying parts of the outer solar system. At present, the Galileo spacecraft flies in repeated comet-like eliptical orbits around Jupiter, flying over the surface of the Galilean moons as low as 261 kilometers (that's lower than the space shuttle orbits the earth, and much lower than most communications satellites). These close approaches result in images with unprecedented detail of selected portions of the moons' surfaces.

Close-up images taken by the Galileo spacecraft of portions of Europa's surface show places where ice has broken up and appeared to float apart, and where liquid seems to have come from below and frozen smoothly on the surface. The lack of many craters on Europa leads scientists to believe that the ocean existed in recent geologic history, and may still exist today. The heat needed to melt the ice in a place so far from the sun is thought to come from inside of Europa, due to a milder form of the tide forces that drives Io's volcanoes. The remarkable contrast between "Fire" and "Ice" on these two neighboring moons has prompted the continuation of the Galileo mission to the end of 1999. In this "Galileo Europa mission", Galileo will spend more than a year repeatedly studying Europa from as close as 200 kilometers, and will see details as small as 2 meters. Then the spacecraft will use the gravity of Callisto to direct its orbit in toward Io, and brave the intense radiation from being so close in to Jupiter, passing through the top of one of Io's volcanic phases and imaging the surface with unprecedented

Fast Facts



Significant Dates

1610— Italian astronomer Galileo Galilei discovers four moons orbiting Jupiter
1973— Pioneer 10 passed within 130,354 km of Jupiter; moons imaged
1979— Voyager 2 passed within 650,000 km of Jupiter; provid ed detailed imagery of Io volcanism
1989— Galileo spacecraft launched (10/18/89)
1995— Galileo began orbiting Jupiter
1996— First high resolution images of Ganymede, Callisto, and Europa
1997— Europa images suggests sub-surface ocean; Galileo Europa Mission begins
1999— First high resolution images of Io planned from 500 km

About the Images

In this composite of images, Jupiter's four largest moons are shown to scale, in order of increasing distance away from Jupiter (from bottom, Io, Europa, Ganymede, and Callisto). The limb of the gaseous giant planet in the region of the Great Red Spot is shown for comparison. All the images were taken by the Galileo spacecraft in 1996 and 1997 during its orbital tour of the Jovian system, except for the globe of Callisto, which was taken in 1979 by the Voyager spacecraft.

The insets are all images from Galileo, taken during several of its closest flybys to the Galilean moons in 1996 and 1997. Two of Io's plumes of cold sulfur dioxide gas and "snow" are shown on the moon's limb (Pillan Petera), and from overhead (Prometheus). Sunlight scattered by ice and dust in Pillan Petera's plume, spewing 140 kilometers above the surface, appears blue against the black of space. Prometheus' towering plume (75 kilometers high) casts a reddish shadow, and appears to have been active since the time of Voyager flybys. On Europa, ice rafts the size of small towns (up to 13 kilometers long) appear to have broken apart and "rafted" on soft ice or ice-crusted water. This image suggests the presence of an ocean underneath Europa's surface some time in recent geologic history. The stereo view of Galileo Regio is reconstructed from two images of Ganymede token on separate close flybys in 1996. Scientists use geometry to accurately compute the heights of features on the surface; the trench in the center of the image is 1 kilometer deep. Glileo Regio has ancient mottled craters and ridges, part of Ganymede's dark terrain. Callisto is famous for its numerous and varied craters. This multi-ringed impact crater named Asgard is surrounded by concentric rings up to 1700 kilometers in diameter. Newer craters, such as Burr in the upper right, are brighter because they expose fresh ice.

References

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